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Gravitational magnetic shocks as a detector of gravitational waves

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Abstract

Gravitational magnetic shock waves, the effect of excitation of a gravitational wave (GW) on shock waves in a highly magnetized plasma, are studied as an effective means for the detection of GW radiated by neutron stars. It is shown that there is every reason to identify the giant impulses of the pulsar NP 0532 with GMSW. © 1997 Published by Elsevier Science B.V.

1. Introduction

The problem of detection of gravitational waves might be unique in the history of twentieth century physics (with the exception of the controlled thermonuclear response problem) in having been investigated for more than thirty years by different research groups using various means without obtaining sufficiently convincing positive results.

The reason for this might be in the incorrectly chosen direction of solution: the development of gravitational wave detectors. The direct detection of GW can be realized using the tidal GW effect on a nonrelativistic detector (solid) or the relativistic GW effect on a detector which has a relativistic component (laser ray). In both cases the GW effect on the detector (the experimental body displacement or the laser ray deviation) is proportional to the GW magnitude. The expected GW amplitudes for astrophysical sources are extremely small (see, for example, Refs. [9,11]). The current programs of gravitational radiation detection are generally for astrophysical sources of two types: (1) supernovae; (2) close double star systems. In the first case a GW amplitude of the order of 10^{-17}-10^{-18} with the radiation in a broad frequency spectral range with a characteristic frequency of the order of 10^3 s^{-1} may be expected; in the second case an amplitude of the order of 10^{-20}-10^{-21} with constant frequency in the interval 0.1-10 s^{-1}. Due to the expected very small amplitude of the gravitational radiation, the experimental programs, oriented on direct gravitational radiation detection, encounter the problems of shot noise and quantum effects. This contradiction has been present for 30 years and demands the creation of high-precision highly-cooled detectors.

On the other hand it is well-known that even such weak-amplitude GW have rather high energies: for the above examples this energy is of the order of W/cm^2 for the first case and of the order of 10^{-13}-10^{-11} W/cm^2 for the second case. The registration of such electromagnetic signals is no problem. Therefore gravitational radiation detection should be studied in a dif-

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